

XERIC HARDPAN FOREST (NORTHERN PRAIRIE BARREN SUBTYPE)

Concept: Xeric Hardpan Forests are woodlands with open vegetation because of restricted rooting depth caused by dense or shrink-swell clay. The Northern Prairie Barren Subtype covers examples on mafic rock-derived soils in the Durham Triassic basin and adjacent areas, which contain a diverse and distinctive herbaceous flora of prairie affinities. They generally have a higher species richness than the Basic Hardpan Subtype. The suite of prairie herbs is different for this region than for the range of the Southern Prairie Barren Subtype, apparently for biogeographic reasons.

Distinguishing Features: The Northern Prairie Barren Subtype is distinguished from the closely related Southern Prairie Barren Subtype by a suite of different species. Species characteristic of the Northern and absent in the Southern include *Echinacea laevigata*, *Oligoneuron album*, *Lithospermum canescens*, and *Baptisia aberrans*. Species characteristic of the Southern and absent in the Northern include *Symphyotrichum georgianum* var. *georgianum*, and *Helianthus schweinitzii*. Both subtypes are distinguished from the closely related Basic Hardpan Subtype and from all other subtypes by the presence of a substantial flora of prairie affinities, beyond widespread species such as *Schizachyrium scoparium*, *Silphium terebinthinaceum*, *Cirsium carolinianum*, *Elymus canadensis*, *Eryngium yuccifolium*, *Liatris squarrosa*, *Parthenium auriculatum*, *Parthenium integrifolium*, *Tragia urticifolia*, and *Sorghastrum nutans* are typical of the both Prairie Barren subtypes and not the other subtypes.

Synonyms: *Quercus stellata* - (*Pinus echinata*) / *Schizachyrium scoparium* - *Echinacea laevigata* - *Oligoneuron album* Woodland (CEGL003558). Diabase Barren (common usage).
Ecological Systems: Piedmont Hardpan Woodland and Forest (CES202.268).

Sites: The Northern Prairie Barren Subtype occurs on broad upland ridgetops or flats underlain by the large diabase sills northeast of the city of Durham.

Soils: Most areas of the Northern Prairie Barren Subtype are mapped as Iredell (Vertic Hapludalf). The more recently defined Picture series (Vertic Argiaquoll) might be applied more widely if they reexamined. As in all the Xeric Hardpan Forests, montmorillonite is the primary clay mineral and vertic properties are believed to be important in creating a stressful environment for woody plants.

Hydrology: Xeric Hardpan Forests are xerohydric but with a predominance of xeric conditions. The soils are drier than is typical in the driest Piedmont sites because of restricted water penetration. However, they may perch water and even pond water locally after heavy rains.

Vegetation: All remaining examples are now heavily altered, but the natural vegetation of this subtype presumably was a savanna or open woodland with a dense grassy herb layer. Treeless patches may have been present and possibly were extensive. The canopy likely was dominated by *Quercus stellata*, with *Pinus echinata* and possibly *Quercus marilandica* abundant or codominant. Other trees such as *Carya carolinae-septentrionalis*, *Carya tomentosa*, *Carya glabra*, *Ulmus alata*, or *Fraxinus biltmoreana* may have been present in smaller numbers, perhaps in groves. In remnants, these species and others such as *Quercus alba* and *Pinus taeda* may be abundant. The understory presumably was sparse in frequently burned examples but is often fairly dense in remnants. Besides the canopy species, *Juniperus virginiana*, *Cercis canadensis*, *Diospyros*

virginiana, or *Acer floridanum* may be abundant, and less characteristic species such as *Prunus serotina* or *Liquidambar styraciflua* may be present. Shrubs in remnants and probably characteristic of natural examples include *Rosa carolina*, *Ceanothus americana*, *Celtis tenuifolia*, and *Rhus aromatica*. The more ruderal *Rhus copallinum* is common in remnants and may also have been present in natural examples. The herb layer is generally dense where tree cover is not heavy. Under a more natural fire regime, it would presumably be very dense and diverse. *Schizachyrium scoparium* probably dominated under such conditions, and *Sorghastrum nutans* may have been abundant. However, these species are not usually strongly dominant in remnants, so this is somewhat uncertain. Herbs found in remnants that likely are characteristic of the natural community include *Danthonia spicata*, *Scleria oligantha*, *Silphium terebinthinaceum*, *Echinacea laevigata*, *Baptisia aberrans*, *Parthenium auriculatum*, *Parthenium integrifolium*, *Lespedeza virginica*, *Lespedeza hirta*, *Ruellia carolinensis*, *Ruellia humilis*, *Dichanthelium laxiflorum*, *Andropogon gyrans*, *Clematis ochroleuca*, *Oenothera fruticosa* var. *fruticosa*, *Scutellaria integrifolia*, *Scutellaria leonardii*, *Tragia urticifolia*, *Silphium asteriscus* var. *asteriscus*, and the additional rare species listed below. Species that appear more ruderal, such as *Apocynum cannabinum* and *Salvia lyrata*, may or may not have been part of the more natural condition.

Range and Abundance: Ranked G1. The subtype appears to be a narrow endemic community confined to the extensive diabase sill area in Durham and Granville counties. No good examples remain, though remnants altered to varying degrees are present in this area. The association may conceivably have occurred in nearby Virginia and a newly discovered large hardpan area there may be related to this subtype.

Associations and Patterns: This subtype once occurred as a large patch community within its range. It grades to Dry Basic Oak–Hickory Forest, possibly to Upland Depression Swamp Forest. Piedmont Headwater Stream Forest (Hardpan Subtype) bands may form or run through it.

Variation: Nothing is known of natural variation, but vegetation may have varied along a moisture gradient.

Dynamics: Dynamics are similar to most of the Piedmont barrens but may be more extreme. Open canopy structure is maintained by dry soil conditions but the natural fire regime would produce a much more open canopy and understory than is seen at present. Because this subtype occurred as larger patches than the Basic or Acidic Hardpan subtypes, with larger area of continuous grass cover, fires may have been more intense and somewhat more frequent. However, most ignitions likely still spread from the surrounding landscape rather than originating within the community. Thus, as with other Xeric Hardpan Forests, fire frequency was presumably similar to that of oak-hickory forests. The open character came primarily from greater fire effects. Fires would probably not be hot enough to harm mature oak or pine trees but would top-kill seedlings and saplings. Most sensitive plant species would be excluded. Most areas of this subtype likely were savannas rather than treeless prairie but trees may have been less dense than in most other subtypes and treeless areas may have been larger under natural conditions.

Lori Sigmon-Chatham's (2015) dendrochronology study at the largest remnant of this subtype shows a dramatic shift in tree regeneration that corresponds with a change in land ownership and can only be due to fire suppression. *Pinus taeda* and *Quercus alba* all date to after this time. The

older *Pinus echinata* and *Quercus stellata* remained but these species almost completely stopped reproducing at the same time.

The warmer, drier Hypsithermal period several thousand years ago may have created more open vegetation across larger parts of the Piedmont. However, the distinctive soils that create Xeric Hardpan Forest were not more widespread. If the characteristic species of the Northern Prairie Barren Subtype once ranged widely, their current rarity and absence in open areas beyond its current range suggest they became restricted long ago. Their survival in the area of this subtype may be due to the larger size of the community patches and their ability to support larger populations. The floristic differences between the Northern Prairie Barren and Southern Prairie Barren subtypes suggests a long separation.

Comments: This subtype is conceived as a richer community than the more widely scattered Basic Hardpan Subtype, probably associated with a center of diversity where hardpans were more extensive. A similar large expanse of habitat on the gabbros of Mecklenburg County and adjacent South Carolina has a diverse but somewhat different flora. It is treated as the Southern Prairie Barren Subtype. This needs further investigation, but study is difficult because of the altered condition of all remnants.

Rare species:

Vascular plants: *Acmispon helleri*, *Agastache nepetoides*, *Baptisia aberrans*, *Baptisia minor*, *Berberis canadensis*, *Callitriche terrestris*, *Carex meadii*, *Delphinium exaltatum*, *Dichanthelium annulum*, *Echinacea laevigata*, *Fleischmannia incarnata*, *Liatris squarrulosa*, *Lithospermum canescens*, *Marshallia legrandii*, *Matelea decipiens*, *Parthenium auriculatum*, *Pseudognaphalium helleri*, *Rhus michauxii*, *Ruellia humilis*, *Packera paupercula* var. *paupercula*, *Panicum flexile*, *Panicum philadelphicum* ssp. *lithophilum*, *Pseudognaphalium helleri*, *Ruellia humilis*, *Scirpus pendulus*, *Scutellaria parviflora*, *Scutellaria leonardii*, *Silphium terebinthinaceum*, *Solidago ptarmicoides*, *Solidago rigida* var. *glabra*, *Symphyotrichum concinnum*, *Symphyotrichum depauperatum*, and *Trifolium reflexum*.

Nonvascular plants: *Astomum ludovicianum*

Invertebrate animals: *Neonympha helicta* and *Bombus affinis*.

References:

Sigmon-Chatham, L.L. 2015. Historic forest structure and composition of the Dry-Mesic Basic Oak–Hickory Forest and Xeric Hardpan Forest community types of the Picture Creek Diabase Barrens: Insights from Dendrochronology. M.S. Thesis, N.C. State University, Raleigh, NC.